ORIGINAL RESEARCH

Trauma Code Protocol: a useful tool for the management of polytraumatized patients at a hospital in Boyacá, Colombia

Protocolo Código Trauma: herramienta útil para el manejo de pacientes politratizados en un hospital de Boyacá, Colombia

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Abstract

Introduction: Polytrauma is the leading cause of death and disability in people <35 years of age, so it is necessary to develop and implement multidisciplinary protocols for their treatment. The Trauma Code Protocol is an interdisciplinary strategy designed to optimize the management of polytraumatized patients and reduce their mortality.

Objective: To describe the sociodemographic and clinical characteristics of polytraumatized patients treated at a hospital in Boyacá (Colombia) using the Trauma Code Protocol.

Methodology: Cross-sectional descriptive study conducted in 100 patients treated at the emergency room of a university hospital in Tunja (Colombia) between 2020 and 2022 using a specific protocol for the management of polytraumatized patients.

Results: The median age of the participants was 34.5 years, 79% were male (95% CI: 70.0-85.8%), and 44% were treated in 2022. The most frequent treating specialties were orthopedics and trauma (69%), neurosurgery (57%), and general surgery (36%). Moreover, the most common diagnoses were head trauma (46%; 95% CI: 36.5-55.7%) and blunt trauma of the chest (n=28; 95% CI: 20.1-37.4%) or abdomen (n=26; 95% CI: 18.4-35.3%). The median values for hemoglobin, pH, base excess, and lactate levels were 12.3 g/dL, 7.34, -7.90 mEq/L, and 3.84 mmol/L, respectively. The median time between activation of the Severe Trauma Team Protocol and surgery was 112 minutes. Finally, 71% of patients survived (95% CI: 61.4-78.9%).

Conclusion: The Trauma Code Protocol is a useful strategy for the management of polytraumatized patients, particularly regarding the early identification of the patient’s sociodemographic and clinical characteristics and its multidisciplinary approach.

Keywords: Multiple Trauma; Cross-Sectional Studies; Clinical protocols; Emergencies; Mortality (MeSH).

Resumen

Introducción. El politratismo es la primera causa de muerte e invalidez en personas <35 años, por lo que es necesario desarrollar e implementar protoclos multidisciplinarios para su manejo. El protocolo Código Trauma es una estrategia interdisciplinaria diseñada para optimizar el manejo de pacientes politratizados y reducir su mortalidad.

Objetivo. Describir las características sociodemográficas y clínicas de pacientes politratizados atendidos en un hospital de Boyacá (Colombia) mediante el protocolo Código Trauma.

Metodología. Estudio descriptivo transversal realizado en 100 pacientes atendidos en el Servicio de Urgencias de un hospital universitario de Tunja (Colombia) entre 2020 y 2022 mediante un protocolo específico de manejo de pacientes politratizados.

Resultados. La mediana de edad de los participantes fue 34,5 años, 79% eran hombres (IC95%: 70,0-85,8%) y 44% fueron atendidos en 2022. Las especialidades tratantes más frecuentes fueron ortopedia y traumatología (69%), neurocirugía (57%) y cirugía general (36%). Además, los principales diagnósticos fueron trauma craneoencefálico (46%; IC95%: 36,5-55,7%) y trauma cerrado de tórax (n=28; IC95%: 20,1-37,4%) o abdomen (n=26; IC95%: 18,4-35,3%). Las medianas de nivel de hemoglobina, pH, exceso de base y nivel de lactato fueron 12,3g/dL, 7,34, -7,90mEq/L, y 3,84 mmol/L, respectivamente. La mediana del tiempo entre la activación del protocolo Equipo Trauma Grave y el manejo quirúrgico 112 minutos. Finalmente, 71% de los pacientes sobrevivieron (IC95%: 61,4-78,9%).

Conclusión. El protocolo Código Trauma es una estrategia útil para el manejo del paciente politratizado en la que destacan la identificación temprana de las características sociodemográficas y clínicas del paciente, y un abordaje multidisciplinario.

Palabras clave: Traumatismo múltiple; Estudios de corte transversal; Protocolos clínicos; Emergencias; Mortalidad (DeCS).
**Introduction**

Approximately 1.25 million individuals die due to traffic accidents every year,¹ making it the sixth leading cause of death and the fifth leading cause of moderate and severe disability worldwide. It is estimated that 1 out of every 10 deaths is caused by trauma, regardless of sex.² Likewise, in people under 35 years of age, polytrauma is the leading cause of death and disability.²

In a retrospective study performed in polytraumatized patients, it was reported that the mean Charlson Comorbidity Index was higher in patients treated in the United States than in those treated in the Netherlands (1.15±2.2 vs. 1.73±2.8; \( p < 0.0001 \)).³ In the same study, patients treated in the United States were discharged to a rehabilitation center more frequently (47% vs. 10%), but in-hospital mortality was similar in both countries (11% vs. 10%).³

Wong & Petchell⁴ assessed, through a survey, the presence, constitution and means of activation of a trauma team in 130 hospitals across Australia, finding that 56% of the hospitals had an established trauma team, while 71% did not have a team. Moreover, 95% of trauma teams were activated by prehospital care services and 92% required a combination of anatomical, physiological, and mechanistic criteria for activation.⁴ In that country, it was necessary to establish the Australian Trauma Registry, which has become a leading clinical quality registry strategy.⁵

According to Hafez et al.,⁶ challenges to the implementation of a trauma system in Egypt include the lack of healthcare infrastructure, such as adequate prehospital care, poor data quality, and a shortage of trained emergency physicians. In turn, Candefjord et al.⁷ compared patient care in trauma and non-trauma centers in Sweden, identifying that adjusted 30-day mortality was 41% lower in specialized care (odds ratio: 0.59 [0.50-0.70], \( p < 0.0001 \)) than in non-specialized care.

In Colombia, the Departamento Administrativo Nacional de Estadística (National Administrative Department of Statistics or DANE by its Spanish acronym) reported that homicides and traffic accidents were the leading causes of violent deaths in 2022.⁸ Furthermore, in a narrative literature review that included 41 studies, Uribe et al.⁹ reported that traffic accidents (24%), suicides (16%), falls (14%), and homicides (10%) were the leading causes of death secondary to external injuries.

Due to its complexity, polytrauma treatment requires a multidisciplinary team capable of making timely decisions, as the prognosis of these patients can change in just a few minutes. Therefore, clinical decisions must be concise and focused on prioritizing and effectively managing lesions and hemodynamic status.¹⁰¹¹ In this sense, the Trauma Code was created as an organized protocol aimed at providing the best possible treatment to polytrauma victims.

In view of the above, the objective of this study was to describe the sociodemographic and clinical characteristics of polytraumatized patients treated at a hospital in Boyacá (Colombia) using the Trauma Code Protocol.

**Methodology**

**Study type**

Cross-sectional descriptive study.
Study population and sample

The study population comprised patients treated in the Emergency Department of the Entidad Social del Estado (ESE) Hospital Universitario San Rafael de Tunja (Colombia) between July 2020 and August 2022 (N=15 168). Patients who met the minimum criteria for Trauma Code Protocol activation were included (n=120), while patients with incomplete data about the main variables of interest in their medical records and those who died before severe trauma team activation were excluded (n=20), thus obtaining a final sample of 100 patients (Figure 1).

Figure 1. Sample selection flowchart.
Source: Own elaboration.

Trauma Code Protocol

The Trauma Code Protocol is activated in the pre-hospital or hospital healthcare scenario provided by basic or medicalized ambulances once the health staff submits to a WhatsApp group the demographic and clinical data of the patient and the context in which the event that led to the polytrauma took place. The chat group is integrated by emergency physicians, orthopedists, general surgeons, urologists, neurosurgeons, and nurses on duty from the ESE Hospital Universitario San Rafael. Likewise, the time of departure to the hospital and the estimated time of arrival is specified, and the referral and counter-referral system is notified.

It should be noted that the Trauma Code may restrict the reception of patients depending on the availability of physical, technical and biological resources at the institution, such as beds (including intensive care beds), blood products, radiological equipment, operating rooms, anesthesiologists, etc. However, up to the time of this study (August 2023), no such situation has occurred.

In the resuscitation room, the first stage of assessment establishes whether the Trauma Code is deactivated or whether the patient meets the minimum criteria for activation of the severe trauma team (<3 minutes; Table 1).
Table 1. Minimum criteria for the activation of the severe trauma team according to the Trauma Code Protocol.

<table>
<thead>
<tr>
<th>Minimum criteria for the activation of the severe trauma team</th>
</tr>
</thead>
<tbody>
<tr>
<td>· Trauma Code activation at the accident scene for priorities 0 and 1.</td>
</tr>
<tr>
<td>· Airway or ventilation compromise.</td>
</tr>
<tr>
<td>· Respiratory rate &lt;10 or &gt;30 respirations/minute.</td>
</tr>
<tr>
<td>· Systolic blood pressure &lt;90mmHg.</td>
</tr>
<tr>
<td>· Heart rate &lt;50 or &gt;120 beats/minute.</td>
</tr>
<tr>
<td>· Glasgow scale score &lt;13, anisocoria or impaired level of consciousness.</td>
</tr>
<tr>
<td>· Revised Trauma Score (RTS) &lt;12.</td>
</tr>
<tr>
<td>· Estimated Injury Severity Score (ISS) score &gt;15.</td>
</tr>
<tr>
<td>· Unstable thorax or pelvis.</td>
</tr>
<tr>
<td>· Limb paralysis or amputation.</td>
</tr>
<tr>
<td>· Penetrating head, neck, or thorax injury.</td>
</tr>
<tr>
<td>· Referral from another healthcare center.</td>
</tr>
<tr>
<td>· Need for blood products (need for massive transfusion).</td>
</tr>
<tr>
<td>· Expected simultaneous arrival of two polytrauma patients at the hospital. Decision of the coordinating physician or members of the resuscitation team.</td>
</tr>
</tbody>
</table>

The criteria highlighted in bold are relevant for the activation of the Trauma Code in the Emergency Department.

Source: Own elaboration.

When the severe trauma team is activated, the second stage of the clinical approach begins, in which care is provided in <10 minutes, including specialty assessment, laboratory tests, imaging tests (X-rays), vital signs monitoring, airway management, pain control and active bleeding management, fluid resuscitation, and other procedures included in the ABCDE algorithm of the Advanced Trauma Life Support (ATLS) system. Also at this stage, it is defined whether patients require immediate surgery or whether they should first be admitted to the intensive care unit (ICU) for clinical and hemodynamic stabilization (Figure 2).

Not all patients were treated in the resuscitation room because, in the presence of hemodynamic instability and other special situations, such as Glasgow Coma Scale score <8 or multiple exposed fractures, they may require immediate management in the operating room or the performance of special or specific invasive procedures (Figure 2).
Finally, in the third stage, patients are taken to the operating room or ICU in less than 30 minutes in order to initiate the relevant therapeutic strategies (medical or surgical). It should be noted that, although patients without life-threatening injuries may require secondary assessment, they are usually taken to the operating room once stage 2 is completed, while those with hemodynamic instability or uncontrolled physiologic deterioration should be admitted to the ICU for stabilization prior to the initiation of surgical management.

Data collection and variables

Patients requiring severe trauma team activation were identified in the daily monitoring book, and the digital clinical records of those who met the eligibility criteria were selected. Data on the following variables were collected from the medical records: age, sex, year of admission, treating specialty, main diagnosis on admission, time between severe trauma team activation and surgery (in minutes), arterial blood gas analysis (pH, lactate level, hemoglobin level, and base excess [BE]), and patient status at discharge (alive or dead).

It is important to point out that arterial blood gas findings were classified into groups according to the ATLS\textsuperscript{12} for BE (poor prognosis: ≤6.1mEq/L) and to Callaway \textit{et al.}\textsuperscript{13} and Regnier \textit{et al.}\textsuperscript{14} for lactate level (poor prognosis: >2.5mmol/L), both of which indicate the risk of favorable or unfavorable clinical outcomes in polytrauma patients. Likewise, age was categorized into age groups taking into account the life cycles proposed by the World Health Organization (WHO); the age range between 12 and 26 years includes adolescence (12-18 years) and youth (14-26 years).

Statistical analysis

Data were entered into a database created in Microsoft Excel for subsequent analysis in the statistical analysis software JASP. Categorical variables are described using absolute and relative frequencies and proportions, and quantitative variables are described using medians and interquartile ranges according to the distribution of the data (Shapiro-Wilks test). Some proportions were expressed as 95% confidence intervals (CI), given the exclusion of >10% (20/120 subjects) of potentially eligible patients. Survival analysis was performed to estimate the time between severe trauma team activation and surgery (in minutes, 95% CI). Finally, box and whisker plots were used to show the distribution of arterial blood gas findings.

Ethical considerations

This research followed the ethical principles for conducting biomedical studies involving human subjects established in the Declaration of Helsinki\textsuperscript{15} and the scientific, technical and administrative standards for health research in Resolution 8430 of 1993 issued by the Colombian Ministry of Health.\textsuperscript{16} In addition, the study was endorsed by the Research and Bioethics Committee of the ESE Hospital Universitario San Rafael de Tunja according to minutes 005-2022. It should also be noted that the database was anonymized to ensure patient confidentiality.

Results

The median age of the participants was 34.5 years and 46% were in the 27-59 age group (n=46; 95% CI: 36.5-55.7%). In addition, 79% were male (n=79; 95% CI: 70.0-85.8%), with a male:female ratio of 3:1. Furthermore, 2022 was the year in which most patients were
treated (44%), followed by 2021 (37%). The most common treating specialties were orthopedics and trauma (69%), neurosurgery (57%), and general surgery (36%) (Table 2).

Table 2. General characteristics of patients treated with the Trauma Code Protocol (n=100).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>2020 (n=19)</th>
<th>2021 (n=37)</th>
<th>2022 (n=44)</th>
<th>Total (n=100)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, in years - median (IQR)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>34.5 (23-50)</td>
</tr>
<tr>
<td>Age group</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-5 years</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>1 (2.2)</td>
<td>1</td>
</tr>
<tr>
<td>6-11 years</td>
<td>0 (0.0)</td>
<td>1 (2.7)</td>
<td>1 (2.2)</td>
<td>2</td>
</tr>
<tr>
<td>12-26 years</td>
<td>6 (31.5)</td>
<td>11 (29.7)</td>
<td>15 (34.0)</td>
<td>32</td>
</tr>
<tr>
<td>27-59 years</td>
<td>9 (47.3)</td>
<td>17 (45.9)</td>
<td>20 (45.4)</td>
<td>46</td>
</tr>
<tr>
<td>≥60 years</td>
<td>4 (21.0)</td>
<td>8 (21.6)</td>
<td>7 (15.9)</td>
<td>19</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>14 (73.6)</td>
<td>31 (83.7)</td>
<td>34 (77.2)</td>
<td>79</td>
</tr>
<tr>
<td>Female</td>
<td>5 (26.3)</td>
<td>6 (16.2)</td>
<td>10 (22.7)</td>
<td>21</td>
</tr>
<tr>
<td>Treating specialties</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orthopedics and trauma</td>
<td>12 (63.1)</td>
<td>28 (75.6)</td>
<td>29 (65.9)</td>
<td>69</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>9 (47.3)</td>
<td>27 (72.9)</td>
<td>21 (47.7)</td>
<td>57</td>
</tr>
<tr>
<td>General surgery</td>
<td>11 (57.8)</td>
<td>14 (37.8)</td>
<td>11 (25.0)</td>
<td>36</td>
</tr>
<tr>
<td>Other*</td>
<td>15 (78.9)</td>
<td>30 (81.0)</td>
<td>14 (31.8)</td>
<td>59</td>
</tr>
</tbody>
</table>

*Other: vascular surgery, plastic surgery, urology, pediatric surgery, adult and pediatric intensive care unit, pediatrics, internal medicine.
IQR: interquartile range.
Source: Own elaboration.

Regarding clinical characteristics, 46% of patients were diagnosed with head trauma (n=46; 95%CI: 36.5-55.7%), 28% with blunt chest trauma (n=28; 95%CI: 20.1-37.4%), and 26% with blunt abdominal trauma (n=26; 95%CI: 18.4-35.3%). It is worth noting that, between 2020 and 2022, the frequency of these three diagnoses decreased, while the frequency of unstable pelvis and femur fracture increased. In addition, 71% of patients survived (n=71; 95%CI: 61.4-78.9%) (Table 2).

As for arterial blood gases, the median values of hemoglobin level, pH, BE and lactate level were 12.3g/dL (range: 4.70-17.4g/dL), 7.34 (range: 6.81-7.65), -7.90mEq/L (range: -30.0-13.4mEq/L), and 3.84 mmol/L (range: 0.61-13.5mmol/L), respectively. When analyzing these four parameters, it was observed that hemoglobin was the parameter with the highest median in all years of the study period. Concerning pH, BE and lactate level, the medians recorded for these parameters suggest that the condition of the patients was critical (lower pH and BE, higher lactate level) (Table 3 and Figure 3).

Table 3. Clinical characteristics of patients treated with the Trauma Code Protocol (n=100).

<table>
<thead>
<tr>
<th>Clinical diagnosis</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2020-2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head trauma</td>
<td>9 (47.3)</td>
<td>23 (62.6)</td>
<td>14 (31.8)</td>
<td>46</td>
</tr>
<tr>
<td>Blunt chest trauma</td>
<td>8 (42.1)</td>
<td>12 (32.4)</td>
<td>8 (18.1)</td>
<td>28</td>
</tr>
<tr>
<td>Blunt abdominal trauma</td>
<td>4 (21.0)</td>
<td>15 (40.5)</td>
<td>7 (15.9)</td>
<td>26</td>
</tr>
<tr>
<td>Femur fracture</td>
<td>2 (10.5)</td>
<td>6 (16.2)</td>
<td>12 (27.2)</td>
<td>20</td>
</tr>
<tr>
<td>Unstable pelvic fracture</td>
<td>1 (5.26)</td>
<td>5 (13.5)</td>
<td>6 (13.6)</td>
<td>12</td>
</tr>
<tr>
<td>Other*</td>
<td>15 (78.9)</td>
<td>30 (81.0)</td>
<td>26 (59.0)</td>
<td>71</td>
</tr>
</tbody>
</table>
Characteristics 2020 2021 2022 2020-2022

<table>
<thead>
<tr>
<th>Arterial blood gases - median (IQR)</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2020-2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hemoglobin level as g/dL - n=95 †</td>
<td>11.4 (9.92-14.7)</td>
<td>12.8 (10.5-14.2)</td>
<td>12.0 (9.20-15.0)</td>
<td>12.3 (10.0-14.6)</td>
</tr>
<tr>
<td>pH</td>
<td>7.38 (7.28-7.40)</td>
<td>7.35 (7.27-7.40)</td>
<td>7.34 (7.26-7.39)</td>
<td>7.34 (7.27-7.40)</td>
</tr>
<tr>
<td>BE as mEq/L - n=99 †</td>
<td>-5.00 (-10.0. -3.60)</td>
<td>-7.10 (-11.6. -4.25)</td>
<td>-9.00 (-11.0. -6.22)</td>
<td>-7.90 (-11.0. -4.50)</td>
</tr>
<tr>
<td>Lactate level as mmol/L</td>
<td>3.88 (2.81-4.75)</td>
<td>2.50 (1.40-5.25)</td>
<td>4.16 (2.80-6.64)</td>
<td>3.84 (2.12-5.67)</td>
</tr>
</tbody>
</table>

Time interval between severe trauma team activation and surgery in minutes

<table>
<thead>
<tr>
<th></th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
<th>2020-2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alive</td>
<td>14 (73.6)</td>
<td>22 (59.4)</td>
<td>35 (79.5)</td>
<td>71</td>
</tr>
<tr>
<td>Dead</td>
<td>5 (26.3)</td>
<td>15 (40.5)</td>
<td>9 (20.4)</td>
<td>29</td>
</tr>
</tbody>
</table>

*Other: multiple head injuries, cellulitis of other parts of the limbs, hemotorax, car passenger injured in a collision, clavicle fracture, multiple trauma in a traffic accident, ankle fracture, temporary skull fracture, open fracture of the temporal bone, scapular fracture, nasal bone fracture, skull fracture, multiple vertebral fractures of the lumbar spine, rib fracture, major alcohol-related trauma, traumatic dissection of the descending aorta, mediastinal hematoma, pulmonary contusion, hypovolemic shock, sprains and strains of other areas and unspecified parts of the lumbar spine and pelvis, femoral diaphysis fracture, spinal cord trauma, open tibia and fibula fracture, subarachnoid hemorrhage, brain death, acute subdural hematoma, complex facial trauma, neurogenic shock, radius and ulna fracture, vascular injury in upper limb, diaphyseal fracture of the humerus, Essex Lopresti luxofracture of the radius, femoral vein injury, severe soft tissue avulsion, circumference degloving leg injury, open femur fracture, Le Fort malar fracture, orbital floor fracture, zygomatic arch fracture, mandibular symphysesis fracture, supratentorial diffuse pneumocephalus, tibial plate fracture, oculair trauma-ocular blindness, firearm injury, cerebral edema, floating knee, open fracture of proximal humerus diaphysis, posterior hip dislocation, occipital epidural hematoma, intertrochanteric femur fracture, facial trauma, distributive shock, metabolic acidosis, anemia, acute respiratory failure, atlantoaxial rotatory subluxation, scrotal edema, alcohol intoxication, hematuria, bladder trauma.

† Some of the patients did not have complete data on these variables due to a lack of analysis and entry of information in the medical records or an error in the reading of arterial blood gas processing.

BE: base excess.

Source: Own elaboration.

**Figure 3.** Overall results of arterial blood gases. A. Hemoglobin level. B. pH. C. Base excess. D. Lactate level. Source: Own elaboration.
Regarding the prognosis of polytraumatized patients according to established cut-off points for the different arterial blood gas parameters, the following was found: 51% had an acidic pH (≤7.34; n=51; 95%CI: 41.3-60.5%); 64% had a BE of poor prognosis (≤-6.1mEq/L; n=64; 95%CI: 54.8-73.3%), and 69% had a lactate level of poor prognosis (≥2.5mmol/L; n=69; 95%CI: 59.3-77.2%). Similarly, poor prognostic hemoglobin levels were found in 61.8% of the men (<14g/dL; n= 47; 95%CI, 50.6-71.9%) and 60.0% of the women (<12g/dL; n= 12; 95%CI, 38.6-78.1%) (Figure 4).

* The cut-off groups were established according to the ATLS12 for base excess and Callaway et al.13 and Regnier et al.14 for lactate level.

**Figure 4.** Distribution of patients by groups in arterial blood gases. A. Hemoglobin level. B. pH. C. Base excess. D. Lactate level. Source: Own elaboration.

The median time between severe trauma team activation and surgery was 112 minutes and increased progressively between 2020 and 2022 (Figure 5).

**Figure 5.** Survival curve of the time elapsed between Severe Trauma Team Protocol activation and surgery. Source: Own elaboration.
Finally, the median age of the patients who died (n=29) was 33.5 years, most were men (n=21), and the main treating services in this subgroup were neurosurgery (n=21) and general surgery (n=13). Also, the median hemoglobin level, pH, BE and lactate level in this group were 13.3g/dL, 7.34, -7.6mEq/L and 4.44 mmol/L, respectively.

**Discussion**

Hoffman et al.\(^{17}\) conducted a systematic literature search to identify the differences between various systems for the treatment of trauma patients in some European countries, the United States and Australia, finding that the presence of a team created specifically for the management of trauma patients (whether unit, department, clinic, team, etc.) contributes positively to the clinical outcomes of the polytraumatized patient. With this in mind, as well as the results of this study, it is essential to implement an organized protocol for the care of polytrauma patients across the country.

In this regard, a study conducted in New Zealand reported that specialized trauma teams are activated by emergency specialists and, through this process, key personnel initially tasked with assessing and treating these patients are mobilized.\(^{18}\) Therefore, a fundamental part of the Trauma Code Protocol is the assessment of the patient by the emergency physician. Although other specialists (e.g. orthopedists, traumatologists, neurosurgeons, general surgeons, etc.) may participate in this assessment, the emergency physician is responsible for the clinical approach to and primary care of these patients.

Furthermore, trauma specialists must constantly seek to update their knowledge of the treatment of these patients.\(^{11}\) In this regard, according to Kazemi & Nayeem,\(^{19}\) changing the attitude of physicians toward injury management is an obstacle, thus protocols for the treatment of polytraumatized patients should also encourage the constant updating of knowledge and ongoing learning of specialized and non-specialized medical personnel. On the other hand, in order to reduce the incidence of polytraumatized patients and improve their prognosis, health systems should take measures to prevent accidents that usually end in polytrauma.\(^{20}\)

The criteria for activating the Trauma Code Protocol are based on the ATLS,\(^{12}\) as it provides a structured and efficient approach to the treatment of multiple trauma patients in the emergency room, which should be coordinated by a trauma professional with extensive experience in the management of these patients.\(^{21}\)

According to Shatney,\(^{22}\) the availability of a trauma team and standardized protocols facilitate the management of the polytraumatized patient. Moreover, Reicks et al.\(^{23}\) emphasize that assessing complications using a standardized multidisciplinary approach is an effective method to care for patients in trauma services. The after-effects of multiple trauma are a serious public health problem, so, in addition to their prevention, the implementation of measures aimed at avoiding preventable deaths and reducing disabilities due to sequelae is essential.\(^{24}\)

In the department of Boyacá (Colombia), there was a significant increase in the number of fatalities in road accidents in 2021, reaching the highest figure in the last 7 years.\(^{25}\) For this reason, it has been proposed to perform an arterial blood gas test as part of the initial assessment of victims of traffic accidents in the department, in order to make timely therapeutic decisions that have an impact on the prevention of complications such as coagulopathy, multiorgan dysfunction syndrome, and death.\(^{26}\)

By applying the Australian\(^{27}\) and American\(^{12}\) guidelines on the management of excessive bleeding and coagulopathy after trauma, trauma protocols reduce mortality and increase survival rates. In Boyacá, by means of the Trauma Code Protocol, a tool has been
implemented to collect sociodemographic and physiological data, which is an important contribution to clinical decision making when managing polytraumatized patients.

Studies on major trauma and major fractures in polytraumatized patients report that there seems to be a higher rate of major trauma and that men are more likely to suffer major injuries than women between the ages of 15 and 44 years.28,29 This is consistent with our findings, as 79% of the participants were men. Regarding age, in this study 46% of the patients were between 27 and 59 years old, with a median age of 34.5 years.

In polytraumatized patients, special attention should be paid to lactate level, as elevated values may signal inadequate perfusion and possible target organ dysfunction in severely injured patients and are associated with mortality.30 This is in agreement with what has been reported in our study, in which more than two thirds of the patients had a poor prognostic lactate level [≥2.5mmol/L] and, in those who died, the median lactate level was 4.44 mmol/L. Similarly, in the study by Ouellet et al.31 conducted in 445 Canadian blunt trauma patients, the baseline lactate levels in non-survivors were found to be significantly higher than in survivors.31

Concerning other arterial blood gas test parameters, Hilbert et al.32 analyzed the correlation between hemoglobin level and tissue perfusion parameters in trauma patients between 2005 and 2011, finding a significant correlation between hemoglobin level and BE (r=0.408; p<0.01); however, there was no significant correlation between hemoglobin and lactate levels. Even though the relationship between arterial blood gas parameters was not evaluated in our study, it is worth mentioning that 51% of the patients had an acidic pH (≤7.34) and 64% had a poor prognostic BE (≤-6.1mEq/L).

A reduction in the time elapsed between the occurrence of trauma and the initiation of definitive treatment has been reported to lead to a reduction in the risk of mortality.20 In addition, it has been demonstrated that a well-organized trauma team can carry out a complete resuscitation in an average time of 56 minutes instead of 122 minutes, more than halving the total time required for resuscitation.33 In this study, the median time between severe trauma team activation and surgery was 112 minutes, which encourages us to reduce these times to minimize the risk of sequelae and mortality, as early intervention has been reported to minimize secondary injuries and the development of severe injuries, in turn improving survival.34

Likewise, it has been reported that the implementation of major trauma management protocols allows the mobilization of health personnel and the necessary resources to provide adequate care to seriously injured patients, achieving a reduction in the time between admission to the hospital and admission to the operating room.35

Several studies have demonstrated the efficacy of trauma teams in the management of polytraumatized patients, resulting in faster treatment times and, therefore, reduced mortality.9,36,37 In this regard, by implementing the Trauma Code Protocol, we have achieved a favorable outcome in most patients (survival: 71%; 95%CI: 61.4-78.9%).

Limitations of this study include, first, that it was conducted in a single hospital in Boyacá, which may restrict the generalization of the findings to other regions or healthcare settings. Second, the study period covers only two years (2020-2022), so the data presented here do not reflect the long-term effects of the implementation of the Trauma Code Protocol.

Despite the aforementioned limitations, this study offers a valuable perspective on the characterization of the use of the Trauma Code Protocol for the management of polytraumatized patients in a hospital in Boyacá. Furthermore, the detailed description of sociodemographic and clinical characteristics of patients provides relevant information for further research and may inspire other healthcare institutions to implement similar protocols.
Conclusions

The Trauma Code Protocol is a useful strategy for the management of polytraumatized patients in which the early identification of the patient’s sociodemographic and clinical characteristics and a multidisciplinary approach stand out. Accordingly, we suggest conducting studies to evaluate the feasibility of replicating it in other healthcare institutions nationwide and worldwide.

Conflicts of interest

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